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## **2014 Space Human Factors Engineering Standing Review Panel**

*Research Plan Reviews for:*

*The Risk of an Incompatible Vehicle/Habitat Design  
The Risk of Performance Errors Due to Training Deficiencies*

*Status Reviews for:*

*The Risk of Inadequate Critical Task Design,  
The Risk of Inadequate Design of Human and Automation/Robotic Integration, and  
The Risk of Inadequate Human-Computer Interaction*

### **Final Report**

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#### **I. Executive Summary and Overall Evaluation**

The 2014 Space Human Factors Engineering (SHFE) Standing Review Panel (from here on referred to as the SRP) participated in a WebEx/teleconference with members of the Space Human Factors and Habitability (SHFH) Element, representatives from the Human Research Program (HRP), the National Space Biomedical Research Institute (NSBRI), and NASA Headquarters on November 17, 2014 (list of participants is in Section XI of this report). The SRP reviewed the updated research plans for the Risk of Incompatible Vehicle/Habitat Design (HAB Risk) and the Risk of Performance Errors Due to Training Deficiencies (Train Risk). The SRP also received a status update on the Risk of Inadequate Critical Task Design (Task Risk), the Risk of Inadequate Design of Human and Automation/Robotic Integration (HARI Risk), and the Risk of Inadequate Human-Computer Interaction (HCI Risk).

Overall, the SRP thought the WebEx/teleconference was very helpful and provided a comprehensive overview of the risks. However, the SRP feels it would be extremely helpful to see the larger strategy for NASA R&D, both in terms of how the different human factors programs relate to the SHFE goals and how they relate to the broader NASA mission. The current roadmap shows the evidence, risks, gaps, and tasks for the areas in the HRP. What is missing is any notion of priorities and timelines for the various areas. While the SRP is able to see priorities within our own area and timelines, it would be helpful to understand how these priorities fit within the larger context of the HRP. An enhanced roadmap should show how all the different areas that were reviewed fit together, how they speak to a larger vision, particularly in terms of how these areas intersect with the larger NASA goals and on what timeline. This roadmap should highlight short-term and long-term research gaps and what the critical milestones would be. Moreover, there needs to be a statement about funding priorities and which areas are critical, especially in light of future NASA missions. Such a roadmap should show how the SHFH areas (specifically HCI, HARI, TRAIN, TASK, and HAB) impact the success of future missions. This would provide not only a better context for the SRP's review but should also provide critical information for funding allocations.

The SRP also feels that the upcoming yearlong missions will be extremely valuable in obtaining information applicable to long-term spaceflights. The SRP thinks it is extremely important to prioritize what experiments need to be run and what data needs to be collected during the one-year International Space Station (ISS) flights as it seems that very few yearlong flights are currently on the books. In addition, it is probable that more evidence will be collected during

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these flights that should be integrated into the existing evidence and may produce new potential risks and associated gaps. While this is not in the scope of the SRP at this time, the SRP thinks it is important to know what steps are being taken to ensure that such information is captured, analyzed, archived, and accessible in such a way that it can inform ongoing and future SHFE goals.

For this review the SRP was asked to focus on the HAB and Train research plans. General comments on these are below. However, focus on the HAB research plan in particular shows many places where it would be beneficial for the SRP to know more about the research plans for the Behavioral Health and Performance (BHP) Element. It would be helpful to provide an overview of their work as a preface to the SRP members.

The SRP is pleased with the current HAB and Train research plans. The SRP thinks the proposed HAB research plan; improved modeling for microgravity, modeling for environmental impacts, and characterizing the changes over time for microgravity; are important. The SRP thinks the training issues pointed out during the discussion (the lack of expertise of the crew in specific spaceflight training and the training time to mission duration time) are of great concern. The general focus on transfer of skill is extremely important, and the most important aspect which is being currently funded. The SRP likes the fact that the SHFE portfolio is partnering with academic institutions that specialize in training and transfer of skill.

The SRP thinks the new NASA solicitations are trying to solicit research in the right direction, especially the push for research in the areas of computational model for habitable volume, the automated collection of space utilization, and the training research. The directed research on guidelines for habitation design and the skills and knowledge underlying training are also good ideas.

The SRP thinks the Habitability Advisory Board is an excellent idea and it should be developed as soon as possible.

Perhaps not critical, but still a potential issue to the SRP is the sheer number of products being developed within the risks to address the various gaps. There are multiple, competing approaches in terms of models, methodologies, etc. being utilized in many cases; especially when work is solicited from external sources. Even within NASA, different Centers seem to be using different tools, equipment or methods for similar HRP projects. At some point, there needs to be an effort towards developing standards for selecting which model/approach/equipment/etc. is preferred and will be pushed out to designers, external agencies (e.g., researchers) and decision makers. Given limited funding, it is also important to select the most promising approach in the different areas and concentrate resources there.

The SRP is still concerned with the small number of subjects being used in the yearlong studies. Dr. Shelhamer noted that the small number in the studies would be augmented with ground-based analogs and studies of shorter duration (six months). The SRP is concerned about how the data is combined; especially if there are only two subjects for the first yearlong ISS study. Sample sizes of that size can only provide anecdotal evidence, not quantitative data. Conducting

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the same studies for six months with more subjects/or with analogs is a good idea but can only be compared, not combined with the longer term studies with small numbers.

Lastly, although the appendix to the 2014 SHFE portfolio presentation contained comments from last year relating to the various gaps and comments by the SRP and the SHFE responses, these were not gone through during the meeting due to time limitations. As the SRP gets involved only annually, it is difficult to recall previous recommendations and to determine if they have been adequately addressed. Having these specifically called out during the yearly meeting would be helpful in understanding the level of concern that can be addressed by the SHFE portfolio.

## **II. Critique of Gaps and Tasks for the Risk of an Incompatible Vehicle/Habitat Design**

1. *Have the proper Gaps been identified to address the Risk?*
  - A. *Are all the Gaps relevant?*
  - B. *Are any Gaps missing?*
2. *Have the appropriate targets for closure for the Gaps been identified?*
  - A. *Is the research strategy appropriate to close the Gaps?*
3. *Have the proper Tasks been identified to fill the Gaps?*
  - A. *Are the Tasks relevant?*
  - B. *Are there any additional research areas or approaches that should be considered?*
  - C. *If a Task is completed, please comment on whether the findings contribute to addressing or closing the Gap*
4. *If a Gap has been closed, does the Rationale for Gap closure provide the appropriate evidence to support the closure?*

### **Gaps and Tasks:**

- The SRP thinks all of the gaps are relevant to the risk, but the list of gaps is incomplete.
- The SRP thinks that thermal and atmospheric (composition, pressure) effects should be discussed. The SRP also thinks that habitability degradation and/or loss over the mission should be considered. Just because a mission started out with enough space does not mean all the space will still be functional or even available at the end of a multi-year mission.
- Although the issue of trash accumulation should be less in these missions than on the ISS, there will still be some accumulation that will impact space in the vehicle.
- The SRP appreciates that an end goal of this Risk is to facilitate integration of SHFE principles to support the final vehicle design, but it's not inconceivable that the optimal design for the humans will turn out to be infeasible from a vehicle performance standpoint. This is another argument for gaining a better understanding of the impact of less than optimal net habitable volumes (NHF) - this design task will likely be an iterative, two-way street. For example, how will tradeoffs be chosen given that "required" elements of the vehicle design may have a subsequently negative influence on another: for example, the human elements (habitability, comfort, metabolic demands, etc.) and the capacity of life support systems to support these elements versus launch/flight/landing parameters (e.g., vehicle mass, total volume, etc.)? What is the

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impact on performance with a less than optimal design element – is the risk tolerable?

- During the SHFH Element Scientist presentation, it was mentioned that habitat design should consider NHV needs and layout considerations, including, “psychosocial considerations”. The SRP thinks this should also include interpersonal space needs for close proximity team activities. This should be one of the “future areas of research” since it depends on how many such team tasks are anticipated (e.g., medical, repairs, large object movements and stowage, etc.). None of the current gaps address two- or multiple-person tasks, nor any NHV (or safety) considerations if some of the team members are robots. There is no specific mention of team task NHV requirements. While many tasks are likely performed by one person, those with two (or more) may involve novel space requirements (either more or possibly even less, because of microgravity). Of particular interest for two person tasks could be medical procedures.

**SHFE-HAB-03: We need to understand how new aspects of the natural and induced environment (e.g., vehicle/habitat architecture, acoustics, vibration, lighting) may impact performance, and need to be accommodated in internal vehicle/habitat design.**

- The SRP thinks this gap is relevant and appropriate.

**Tasks:**

- Vehicle NHV and Habitability Assessment – PI: Sherry Thaxton, Ph.D. – NASA Johnson Space Center
  - This is scheduled to be conducted every two weeks – 25 total observations expected. The PI will get data within five days from when it is collected and will correlate data to NHV tasks and to crew debriefs. The SRP thinks the PI should try to get some information from the crew prior to crew debriefs as it may be difficult for the crew to recall some of this by the end of the one-year mission.
- Display Reading Performance Under Lateral Whole-Body Vibration Due to 12-Hz Thrust Oscillation – Completed Task
- Combined whole-body vibration plus G-loading influences on visual performance and operator ratings – Completed Task
- SDBI 1904 - Human Factors Assessment of Vibration Effects on Visual Performance During Launch – Completed Task
- Space Craft Internal Acoustic Environment – Completed Task

**SHFE-HAB-05: We need to understand what aspects of human physical capabilities and limitations (e.g., body size and shape, range of gross movement) change for predetermined mission attributes, and need to be accommodated in internal vehicle/habitat design.**

- The SRP thinks this gap is relevant and appropriate.
- The SRP wonders if the preferences or dislikes of team tasks are known. Also, do “non-standard” microgravity operating postures interfere with task communications, interpersonal coordination or personal space considerations?
- The SRP recommends clarifying the “Interim Steps” for this gap. Specifically what is meant by the term “individual variance”? Perhaps there are local changes in the body strength due to long-term microgravity and exercise regimens which may overlook critical task performance requirements (e.g., wrist torque exertion changes). These may already be known, but the SRP thinks they should be mentioned here even if so and

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certainly if not.

Tasks:

- Quantification of In-flight Physical Changes - Anthropometry and Neutral Body Posture (NBP) – PI: Sudhakar Rajulu, Ph.D. – NASA Johnson Space Center
- Spinal Elongation and its Effects on Seated Heights in a Microgravity Environment – Completed Task

**SHFE-HAB-07: We need design guidelines for acceptable net habitable volume and internal vehicle/habitat design configurations for predetermined mission attributes.**

- The SRP thinks this gap is relevant and appropriate.

Task:

- Design Guidelines for Net Habitable Volume (NHV) and Internal Habitat Layout Configurations – Planned Task
  - This task will provide deliverables of both an unvalidated NHV process report and a validated NHV process report. The SRP thinks it should also include how the NHV process report will be validated.

**SHFE-HAB-08: We need to refine the definition of the Risk of Incompatible Vehicle/Habitat Design including mission attribute list, and define the acceptable level of risk due to inadequate internal vehicle/habitat design.**

- The SRP thinks this gap is relevant and appropriate.

Tasks:

- HAB Definition and Risk Level Refinement – Planned Task
- Future Vehicle Environment (Research Requirements) – Unfunded Task/Not within Current Budget
- Team NHV Questionnaire with SHFH Study – Planned Task
- Team NHV (Research Requirements) – Unfunded Task/Not within Current Budget
- Future Vehicle Environment Questionnaire – Planned Task

**SHFE-HAB-09: We need to identify technologies, tools, and methods for data collection, modeling, and analysis that are appropriate for design and assessment of vehicles/habits (e.g., net habitable volume, layout, and usage) for predetermined mission attributes, and for refinement and validation of level of acceptable risk.**

- The SRP thinks this gap is relevant and appropriate.
- The SRP thinks the “Rationale” for this gap is rather negative. While there is indeed no NASA standard human model, NHV assessment can surely use some computational human models, even if they are just anthropometrically scaled from the existing astronaut population. By applying the known size changes from long-duration microgravity missions, they may still be usable for the mathematical (optimization) approach to NHV estimation and analysis. Such models may be even more critical for understanding NHV requirements for two or more person tasks in microgravity.

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### Tasks:

- A Tool for the Automated Collection of Space Utilization Data – PI: Gordon Vos, Ph.D.  
– NASA Johnson Space Center
- Objective Crew Task Performance – Planned Task
  - The SRP assumes that the metrics (time, errors, having to consult the “documentation”, situation awareness) are already known. The SRP is unsure what the goal of this task is. Is it to establish a baseline for different tasks that can be used as a guideline for how the crew is doing in microgravity and after different lengths of time?
- Automatic Video-based Motion Analysis – PI: Neal Checka – Vecna Technologies, Inc.
  - The SRP thinks that this is an important task and that it can be extremely useful in capturing data in the vehicle.
- Computational Model for Spacecraft/Habitat Volume – PI: Sherry Thaxton, Ph.D. – NASA Johnson Space Center
- Habitable Volume and Space Utilization Assessment Tool Validation on the International Space Station – Unfunded Task/Not within Current Budget
  - The SRP thinks this is an important task and recommends prioritizing this for funding.
- NHV Data Acquisition Tools – Planned Task
- Semantic Language and Tools for Reporting Human Factors Incidents - Phase III – PI: Debra Schreckenghost – TRACLabs
- Validation and Refinement of NHV and Habitability Tools and Models – Planned Task
- Habitability-Human Factors and Habitability Assessment Tool – Completed Task
- Semantic Language and Tools for Reporting Human Factors Incidents – Completed Task

### **III. Critique of Gaps and Tasks for the Risk of Performance Errors Due to Training Deficiencies**

1. *Have the proper Gaps been identified to address the Risk?*
  - A. *Are all the Gaps relevant?*
  - B. *Are any Gaps missing?*
2. *Have the appropriate targets for closure for the Gaps been identified?*
  - A. *Is the research strategy appropriate to close the Gaps?*
3. *Have the proper Tasks been identified to fill the Gaps?*
  - A. *Are the Tasks relevant?*
  - B. *Are there any additional research areas or approaches that should be considered?*
  - C. *If a Task is completed, please comment on whether the findings contribute to addressing or closing the Gap*
4. *If a Gap has been closed, does the Rationale for Gap closure provide the appropriate evidence to support the closure?*

### **Gaps and Tasks:**

- In general, the SRP thinks the gaps are appropriate and relevant.
- The SRP is not convinced the current gaps are comprehensive, but training is an extremely broad area to cover. Moreover, as noted in the discussion the issue of training

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here is very different and will cover not only technical training, but “problem solving” training and behavioral and communication skills.

- The SRP thinks that training should also focus on teams of humans, teams of humans and robots, as well as individual training. This overlaps with other risks such as TASK, HARI and HCI.
- The SRP thinks training is focused on developing systems to effectively train and assess the cognitive aspects (i.e., knowledge components). Tasks in the various gaps should address not only the cognitive aspects (knowledge) but also the motor aspects (skills). Currently the tasks appear to be almost exclusively oriented towards addressing the knowledge aspects.

**SHFE-TRAIN-01: We do not know which validated objective measures of operator proficiency and of training effectiveness should be used for future long-duration exploration missions. (Previously: How can we develop objective training measures to determine operator proficiency during and after ground training?)**

- The SRP thinks this gap is relevant and appropriate.
- The SRP wonders why these measures would not be the same as objective measures of crew performance (gap SHFE-HAB-09 task)?
- Both SHFE-TRAIN-01 and SHFE-HAB-09 deal with operator proficiency (crew performance measures) and training effectiveness. The SRP recommends that these two gaps should reference each other or possibly be combined.

**Tasks:**

- Formal Objective Measures of Training Effectiveness – Unfunded Task/Not within Current Budget
- Validated Formal Objective Measures of Operator Proficiency – Unfunded Task/Not within Current Budget
- Validated Formal Objective Measures of Training Effectiveness – Unfunded Task/Not within Current Budget
- Spaceflight Resource Management Training – Completed Task

**SHFE-TRAIN-02: We need to identify effective methods and tools that can be used to train for long-duration, long-distance space missions. (Previously: How do we develop training methods and tools for space medical application if time is minimal?)**

- The SRP thinks this gap is relevant and appropriate and should be prioritized for funding. Currently only two of the seven tasks suggested are either funded or completed.
- One possibility would be to investigate the notion of gamifying some of the training, particularly for teamwork and even to facilitate communication (such as the existing SpaceTeam App).

**Tasks:**

- Customized Refresher and Just-in-Time Training for Long-Duration Spaceflight Crews (NSBRI, Robinson) – PI: Stephen Robinson, Ph.D. – University of California, Davis
- Evaluation of Task-Skill-Knowledge JIT techniques for medical and other emergency events – Unfunded Task/Not within Current Budget

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- The SRP thinks that the work of Dr. David Kieras at the University of Michigan should be looked at. He has developed a technique for flexible exposure of detail level based on user skill level.
  - ISS Training Best Practices and Lessons Learned – Unfunded Task/Not within Current Budget
    - The SRP thinks this will be a very useful task and that it will help in learning things that are difficult and take more time in the training. This should also help with developing training that emphasizes issues that past astronauts have found challenging.
  - Methods and Tools for Initial Earth-Based Training – Unfunded Task/Not within Current Budget
    - The SRP thinks that user modeling is something that could possibly help here. Knowing what each individual crewmember knows, has trained on, how they like their training customized, etc., could certainly help to make training less boring and more challenging.
    - Learning strategies should be built into systems design and documented as training materials.
  - Methods and Tools for Just-In-Time Training for Normal Operations – Unfunded Task/Not within Current Budget
    - The SRP recommends using something like Google glass here to bring up procedures, show photos, etc., and even film what the crew is doing.
  - Methods and Tools for Real-Time Performance Support – Unfunded Task/Not within Current Budget
  - Medical Proficiency Training – Completed Task

**SHFE-TRAIN-03: We need to develop guidelines for effective onboard training systems that provide training traditionally assumed for pre-flight. (Previously: How can onboard training systems be designed to address Just in Time (JIT) and recurrent training needs for nominal and off nominal scenarios?)**

- The SRP thinks this gap is relevant and appropriate. This gap should also be prioritized.

**Tasks:**

- Effective On-Board Training for Dynamic Operations – Unfunded Task/Not within Current Budget
- Effective On-Board Training for Payload and Maintenance Operations – Unfunded Task/Not within Current Budget
- Effective On-Board Training for Vehicle Systems – Unfunded Task/Not within Current Budget
- Required Level of Fidelity Necessary for Effective Simulation – Planned Task
- Topics Appropriate for On-Board training (OBT) – Unfunded Task/Not within Current Budget
- Just in Time Simulation Platform – Completed Task

**SHFE-TRAIN-04: We do not know the types of skills and knowledge that can be retained**

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**and generalized across tasks for a given mission to maximize crew performance.**

- The SRP thinks this gap is relevant and appropriate and certainly should be prioritized for funding.

**Tasks:**

- Skills and knowledge underlying crew performance: A general taxonomy – Planned Task
- Generalizable skills and knowledge for Exploration missions – Planned Task
- Effects of Long-Duration Spaceflight on Training Retention – PI: Immanuel Barshi, Ph.D. – NASA Ames Research Center
  - This tasks talks about reducing the ISS training flow. Does this mean that training will be shortened or will some onboard training for tasks that crew on the ISS will be doing be provided?
  - The SRP thinks another important training factor is not just individual training but team training where two or more astronauts/and or robots will be involved.

**IV. Discussion on the strengths and weaknesses of the IRP and identify remedies for the weaknesses, including answering these questions:**

- A. Are the Risks addressed in a comprehensive manner?
  - The SRP thinks the Risks are addressed in a comprehensive manner.
- B. Are there areas of integration across HRP disciplines that are not addressed that would better address the HAB and Train Risks?
  - During the WebEx presentation, the SHFE portfolio identified good collaborations with BHP, Occupant Protection, Advanced Exploration Systems, and Extravehicular Activity groups. The SRP thinks these interactions should provide interesting information. However, it would help the SRP if we could see the gaps and research focus of the BHP overall, rather than just specific overlaps.
  - Although the SRP thinks all areas of integration are currently being addressed, some new interactions may emerge as the HAB risk is better defined.
  - Teamwork may be a place that will suffer from conflicts with team workers as much time is spent in very cramped quarters. It may be that different assignments have to be made as crewmembers find themselves working more effectively with other crewmembers.

**V. Evaluation of the progress on the HAB and Train Risks Research Plans since the 2013 SRP meeting**

- The SRP is very impressed with the progress made in the IRP since the 2013 SRP meeting.
- The SRP thinks the organization of the research plans has improved noticeably over the last year.

**VI. Additional Comments regarding the Risk of Inadequate Critical Task Design (Task) Status Review**

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- Slides 93 and 95 of the 2014 SHFE Portfolio presentation have different wording for TASK 2 and TASK 3.
  - The SRP is not yet convinced that this area should be merged with other SHFE risks and recommends waiting to see what the human performance data says with respect to this.
  - The SRP thinks that with respect to SHFE-TASK-02, task design and systems use are two sides of the same coin. Systems should be designed with task-based use-cases.

## VII. Additional Comments regarding the Risk of Inadequate Design of Human and Automation/Robotic Integration (HARI) Status Review

- The SRP is pleased with the revised HARI gaps.
- The SRP thinks there is considerable overlap between the HARI and HCI risks/gaps (e.g., functional allocation; verification methods) that warrant further exploration and possible collaboration. Specifically, SHFE-HARI-03 and SHFE-HCI-05.
- Level of automation (design of functionality) is a common gap.
- HCI often does the planning for robotic missions, and then HARI carries them out.
- Major distinction is a HARI product of work results in a change to the physical world, but HCI product is often conceptual and does not immediately change the physical world.
- The SRP thinks it is good that SHFE-HARI-02 will obtain information from multimodal displays for surface telerobotics, but there will still be more displays needed for HARI tasks.
- HARI technologies will continue to change rapidly. During the period leading up to design freeze for next mission spacecraft, the SRP thinks task analysis and design methods should be developed that are independent of current robotic and automation technology. For example, an HRI experiment at the NASA Ames Research Center back in 1999 used “capability” of a team member to request assistance.
- Also, situation awareness (SA) is something that the crew should have at all times concerning automation – as well as regain it when lost. SA is dynamic – as systems and environments change, so does SA. Therefore, the SRP recommends rewording the unfunded task, Quantification and Mitigations for Loss of Situation Awareness during Transitions between Levels of Automation, to reflect that.
- The SRP thinks the unfunded task, Automation Trust and Complacency, should not just look at understanding the relationship between humans, automation/robots, and trust works but understand how these relationships work and the impact of computer mediation on these relationships.
- The SRP is concerned about how to engage more of the other Risks, who should be concerned about training in their specific areas. HARI in particular is a place where teleoperations will need to be carried out and developing training that simulates this will be important. Continual practice for teleoperations is a must so this is an area the SRP thinks needs to be looked into.
  - Reference – an article in Human Performance in Space: Advancing Astronautics Research in China, “Spaceflight operation skills: effects of

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operation complexity and training method” by Y. Zhang, M. Wang, P. Li, B. Wu, W. Huang, S. Chen – most from the National key Laboratory of Human Factors Engineering, China Astronaut Research and Training Center in Beijing. shanguang\_chen@126.com is the contact for this paper.

## VIII. Additional Comments regarding the Risk of Inadequate Human-Computer Interaction (HCI) Status Review

- The SRP does not know what human centered methods are currently used to develop requirements for design and how these requirements are enforced by NASA. Certainly the requirements for the next generation vehicle will be greatly informed by research that is spelled out here. How will these requirements be delivered to contractors and enforced by NASA?
- With respect to the SHFE-HCI-02 unfunded task, Effects of Attentional Variations and Cognitive Load on Long-duration Task Performance, the SRP recommends performing a cognitive work analysis task on the ground – then given that cognitive decline in a long-duration mission can be measured, see which of these tasks are in danger.
- With respect to the SHFE-HCI-06 unfunded task, Information Architecture and Integration for Exploration Missions, the SRP thinks the task should be driven by workflow requirements for information use and change, e.g., JIT access to information.
- If not already planned, the SRP thinks the new interfaces created using the Human Factors Analysis Support Tool (H-FAST) should be evaluated by HCI experts to determine if they provide the required functionality and if the usability level is acceptable.
- The SRP thinks that HCI tasks (i.e., SHFE-HCI-04) should not be dictated by emerging technologies likely to be obsolete by 2020. Where possible, needs/task analysis and system requirements should drive the projects selected and how they are conducted.
- The HCI user interface technologies will continue to change rapidly. During the period leading up to design freeze for next mission spacecraft, the SRP thinks HCI analysis and design methods should be developed that are independent of the user interface technology. Design validation for SHFE-HCI-05 should be first priority.

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## **IX. 2014 SHFE SRP Research Plan Reviews: Statement of Task for the Risk of an Incompatible Vehicle/Habitat Design (HAB) and the Risk of Performance Errors Due to Training Deficiencies (Train)**

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The 2014 Space Human Factors Engineering (SHFE) Standing Review Panel (SRP) is chartered by the Human Research Program (HRP) Chief Scientist. The purpose of the SRP is to review the Risk of an Incompatible Vehicle/Habitat Design, and the Risk of Performance Errors Due to Training Deficiencies sections of the current version of the HRP's Integrated Research Plan (IRP) which is located on the Human Research Roadmap (HRR) website (<http://humanresearchroadmap.nasa.gov/>). Your report, addressing each of the questions in the charge below and any addendum questions, will be provided to the HRP Chief Scientist and will also be made available on the HRR website.

### **The 2014 SHFE SRP is charged (to the fullest extent practicable) to:**

1. Based on the information provided in the current version of the HRP's IRP, evaluate the ability of the IRP to satisfactorily address the Risk by answering the following questions:
  - A. Have the proper Gaps been identified to address the Risk?
    - i) Are all the Gaps relevant?
    - ii) Are any Gaps missing?
  - B. Have the appropriate targets for closure for the Gaps been identified?
    - i) Is the research strategy appropriate to close the Gaps?
  - C. Have the proper Tasks been identified to fill the Gaps?
    - i) Are the Tasks relevant?
    - ii) Are there any additional research areas or approaches that should be considered?
    - iii) If a Task is completed, please comment on whether the findings contribute to addressing or closing the Gap.
  - D. If a Gap has been closed, does the rationale for Gap closure provide the appropriate evidence to support the closure?
2. Identify the strengths and weaknesses of the IRP, *and* identify remedies for the weaknesses, including, but not limited to, answering these questions:
  - A. Is the Risk addressed in a comprehensive manner?
  - B. Are there areas of integration across HRP disciplines that are not addressed that would better address the Risk?
  - C. Other
3. Based on the updates provided by the Element, please evaluate the progress in the research plan since the last SRP meeting.
4. Please comment on any important issues that are not covered in #1, #2, #3 or #4 above, that the SRP would like to bring to the attention of the HRP Chief Scientist and/or the Element.

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### **Additional Information Regarding This Review:**

1. Expect to receive review materials at least four weeks prior to the WebEx conference call.
2. Participate in a WebEx conference call on November 17, 2014 from 3:00 – 6:30 pm ET.
  - A. Discuss the 2014 SHFE SRP Statement of Task and address questions about the SRP process.
  - B. Receive presentations from the Space Human Factors and Habitability (SHFH) Element; participate in a question and answer session, and briefing.
3. Prepare a draft final report (approximately one month after the WebEx conference call) that contains a detailed evaluation of the current IRP specifically addressing items #1, #2, #3, and #4 of the SRP charge. The draft final report will be sent to the HRP Chief Scientist and he will forward it to the appropriate Element for their review. The SHFH Element and the HRP Chief Scientist will review the draft final report and identify any misunderstandings or errors of fact and then provide official feedback to the SRP within two weeks of receipt of the draft report. If any misunderstandings or errors of fact are identified, the SRP will be requested to address them and finalize the 2014 SRP Final Report as quickly as possible. The 2014 SRP Final Report will be submitted to the HRP Chief Scientist and copies will be provided to the SHFH Element that sponsors the SHFE portfolio and also made available to the other HRP Elements. The 2014 SRP Final Report will be made available on the HRR website (<http://humanresearchroadmap.nasa.gov/>).

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**X. 2014 SHFE SRP Status Review (WebEx/Telecon): Statement of Task for the Risk of Inadequate Critical Task Design, the Risk of Inadequate Design of Human and Automation/Robotic Integration, and the Risk of Inadequate Human-Computer Interaction**

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The 2014 Space Human Factors Engineering (SHFE) Standing Review Panel (SRP) will participate in a Status Review that will occur via a WebEx/teleconference with the Human Research Program (HRP) Chief Scientist, Deputy Chief Scientist and members of the Space Human Factors and Habitability (SHFH) Element. The purpose of this review is for the SRP to:

1. Receive an update by the HRP Chief Scientist or Deputy Chief Scientist on the status of NASA's current and future exploration plans and the impact these will have on the HRP.
2. Receive an update on any changes within the HRP since the 2013 SRP meeting.
3. Receive an update by the Element or Project Scientist(s) on progress since the 2013 SRP meeting.
4. Participate in a discussion with the HRP Chief Scientist, Deputy Chief Scientist, and the Element regarding possible topics to be addressed at the next SRP meeting

The 2014 SHFE SRP will produce a report/comments from this status review within 30 days of the 2014 update. These comments will be submitted to the HRP Chief Scientist and copies will be provided to the SHFH Element that sponsors the SHFE portfolio and also made available to the other HRP Elements. The 2014 SRP Final Report will be made available on the Human Research Roadmap public website (<http://humanresearchroadmap.nasa.gov/>).

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## XI. SHFE SRP Research Plan Review WebEx/Teleconference Participants

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**SRP Members:**

Jean Scholtz, Ph.D. (chair) – Battelle Memorial Institute  
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## XII. 2014 SHFE Standing Review Panel Roster

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